REMARKS

Method claims 1-8 have been amended so they are consistent with corresponding apparatus claims. The Examiner is again requested to reconsider the restriction requirement between the method and apparatus claims because these claims do not define separate and distinct inventions. A proper and complete search of the apparatus claims should include a search of the relevant method subclasses.

Claim 12 has been amended so it now depends on claim 11. The claims have been amended to overcome the rejection of claims 11-25 and 31-33 under 35 USC §112, paragraph 2, and to define applicants' contribution to the art with greater particularity. However, applicants have not amended claims 11 and 21-23 as a result of the objection to these claims. The Examiner is requested to explain why she believes the phrase "the remainder of the coil" is confusing. The Examiner's suggestion to change that phrase to "another of the windings" is unacceptable to applicants because the suggestion tends to narrow the claims. All claims now define a vacuum plasma processor.

Claims 26 and 27 have been previously canceled and a divisional application has been filed thereon.

Claim 11, particularly as amended, distinguishes over the art of record. Claims 11 and 31 now distinguish over Ishii et al., US Patent 5,571,366 by requiring the parallel windings to be connected to be driven by the output of a source so the source supplies current in parallel to the parallel connected windings. Because the Ishii et al. windings are driven by separate RF sources different <u>parallel</u> currents from the source do not flow in the windings.

Claims 11 and 31 further distinguish over Ishii et al., as well as Sato et al., US patent 5,907,221, and Chu et al., US patent 6,051,073, by requiring the controller to directly vary the output power of the source and the values of the components of the variable impedance arrangements so that for different distributions of the electromagnetic fields the coil supplies different amounts of total power and different relative currents to the windings. Such a controller provides greater control than Ishii et al. provides since Ishii et al. does not discuss (1) varying the output power of 7A or 7B or (2) varying values of components of variable impedance arrangement.

Ishii et al. and says controller 37 varies the potential or current of antennae 6. The controller of claims 11 and 31 also provides greater control than can be obtained by varying the matching network driven by generator 66 of Chu et al. or the control which is provided for the values of the variable capacitors of Sato et al. In Sato et al., capacitors 160 are in series between matching networks 165 and parallel connected windings 150 that are responsive to RF source 170. Controller 180 controls the value of each variable capacitor. In Chu et al., RF source 66 drives windings 46 in parallel by way of matching network 50. Fixed capacitor 54 is connected in series between the output terminal of matching network 50 and one terminal of each of windings 46. Each of windings 46 is shunted by a variable capacitor. The power supplied to winding 46 is stated to be controlled by controller 62 supplying signal F to matching network 50. Chu et al. states "in one embodiment, the RF generator 66 is controlled by a signal E from the controller 62. In one embodiment, the controller 62 controls the power to the antenna by a signal F to the matching network 50." Hence, Chu et al. has no specific indication that the controller directly controls the output power of generator 66. Applicant, by directly varying the output power of generator 66 and varying the components of the variable impedance arrangements is able to obtain more precise control over the distributions of the electromagnetic fields the source supplies to the parallel connected windings.

A controller to directly vary control the output power of the source as now defined by claims 11 and 31 is advantageous over Chu et al. Greater control is provided by direct control of the output power than can be obtained by varying the matching network which is driven by generator 66 of Chu et al. Matching networks are typically employed to maintain an impedance match between the output impedance of an RF source and the load being driven by the source and to provide tuning between the load and source. Because matching networks are used for these purposes, matching networks do not provide direct control of the power supplied to the coil. Instead, the matching network reactances are varied to provide impedance matching and tuning. Direct control of the power supplied to the coil is not achieved by controlling the Chu et al. matching network to obtain such an impedance match. In Sato et al., control of capacitors 160 affects the impedance match and tuning between the output of source 170 and the impedance of the windings. Hence, direct control of the power supplied to the coils is not achieved.

The various rejections against claims 12, 32 and 33 are incorrect. There is no basis in the record for the Examiner's comment that it would have been an obvious choice of design to one of

ordinary skill in the art to arrange the controller so that the current flowing in one of the windings is substantially constant while the current in the remaining winding changes to control the distribution and uniformity of the plasma, as claim 12 requires. There is also no basis for the Examiner's comment that it would have been an obvious design choice to arrange the Chu et al. controller so that the current applied to the exterior winding is varied in order that the magnetic field generated by the exterior windings exceeds, is less than or is the same as the electromagnetic field generated by the remainder of the coil to control the distribution and uniformity of the plasma..

The Examiner's statement that the features of claims 12, 32 and 33 are obvious because Chu et al. "is capable of controlling the total power and variable impedance arrangements in the different windings" is not the proper basis for an obviousness rejection. There must be some suggestion in the art to provide a controller as set forth in claims 12, 32 and 33. The Examiner must present evidence as to why it would have been obvious to one of ordinary skill in the art to provide a controller having the foregoing characteristics. In order for the Examiner to establish a *prima facie* case of obviousness, all the claim limitations must be taught or suggested by the prior art. *In re Royka, 490 F2d 981, 180 USPQ 580 (CCPA 1974).* The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills, 916 F2d 680, 16 USPQ 2nd 1430 (Fed. Circuit 1990).* In the present case, the Examiner has not provided any suggestion that the combination is desirable. Consequently, the Examiner's rationale to reject claims 12, 32 and 33 is contrary to established law.

Claims 11, 12, 31-33 are not obvious as a result of Sato et al. US patent 5,907,221 in view of Tomioka et al., US patent 5,897,713 or Chu et al., cited by the Examiner as US patent 6,052,073 (sic: apparently US patent 6,051,073). The Examiner recognizes that Sato et al. fails to disclose varying the total power applied to plural parallel connected windings, but relies on Tomioka et al. or Chu et al. for this feature. As previously discussed, Chu et al. does not disclose the features of claims 11 and 31 relating to direct control of the output power of the RF source. Hence, the combination of Sato et al. and Chu et al. to reject claims 11, 12, and 31-33 is improper.

With regard to the rejection of claims 11, 12, 31-33 as being obvious as a result of Sato et al. and Tomioka et al., Tomioka et al. does not disclose plural parallel connected windings. Instead, in Tomioka et al. RF sources 7 and 10 respectively drive windings 3 and 4. Windings 3 and 4 and

corresponding windings, such as windings 32 and 33, Figure 5 are not connected in parallel but are separately driven by sources 7 and 10. Controller 14 is stated to control the frequencies, phases and powers of RF power sources 7 and 10 and the RF bias power supply 13. According to one aspect of Tomioka et al., as set forth in column 3, lines 26-36, and 41-55, the two RF power supplies have frequencies that differ from each other such that mutual interference of the powers the sources supply to the coils causes a synthesized wave having a periodically changing amplitude to be generated in a process room, i.e., a plasma chamber. The synthesized wave produces a synthesized electric field wave which ions in the plasma can follow to control the progress of dissociation of the process gas in the plasma. Another aspect of the Tomioka et al. arrangement involves controlling the first and second RF supplies so they apply different powers to the two coils. The difference between the two RF powers is also used to control the progress of dissociation of the process gas in the plasma; see column 4, lines 5-10 and lines 17-25.

Sato et al. is concerned with providing a uniform plasma ion density distribution across the substrate surface. In the embodiment of Figure 6, the power supplied to each of the coils is determined by the value of capacitors 160a-160k, respectively connected to coils 150a-150k. There is no control of the output power of the source driving the coils.

Applicants cannot agree that it would have been obvious to one of ordinary skill in the art to have modified Sato et al. as a result of Tomioka et al. The purpose of the variable power aspects of Tomioka et al. is entirely different from variable power that Sato et al. employs. Applicants, by directly varying the total power and varying the values of components of variable impedance arrangements, attains considerably more control than Sato et al. attains. Since Tomioka et al. is interested in controlling the power that supplies 7 and 10 supply to two different coils to control the progress of dissociation of a process gas in the plasma, i.e., for a reason entirely different from the reason Sato et al. wants to control power, one of ordinary skill in the art would not have combined Tomioka et al. and Sato et al. Applicants' arrangement provides far greater control than Sato et al. attains.

The foregoing discussion of Sato et al. and Tomioka et al. indicates one of ordinary skill in the art would not have modified Sato et al. to vary the output power of source 170 as a result of the Tomioka et al. disclosure.

The Examiner, in combining Tomioka et al., with Sato et al. has merely cast around to find references having features defined by applicants' claims and used hindsight to combine them. The Examiner has not provided a motivation to combine Tomioka et al. and Sato et al., as required by *in re Kotzab, 217 F.3d 1365, 1371, 55 USPQ 2nd 1313, 1318 (Fed. Circuit 2000)*. The fact that the references relied upon disclose all aspects of the claimed invention and those aspects were individually known in the prior art is not sufficient to establish a prima facie case of obviousness, without some objective reason to combine the disclosures of the references. *Ex parte Levengood, 28 USPQ 2nd 1300 (Board of Patent Appeals and Interferences 1993).*

The Examiner's assertion that the features of claims 12, 32 and 33 are obvious from Sato et al. in view of Tomioka et al. or Chu et al., in combination with the Examiner's conclusion that the claimed features are a matter of design choice is without merit. The Examiner has offered no rationale as to why the features of claim 12, 32 and 33 are a matter of design choice. Claim 12, for example, requires a controller coupled to the impedance arrangement and power source for varying the impedance arrangements and directly varying the total power the source supplies to the plural connected windings and components of the variable impedance arrangements so that for different distributions of electromagnetic field generated by and supplied by the different windings to the plasma, the current flowing in one of the windings remains substantially constant and the current in the remainder of the coil changes. Such control assists in enabling applicants to attain better control over the density of plasma in the chamber.

Claim 32, which is now an independent claim, requires a controller to be arranged for varying the current supplied by a source to the windings of a coil for causing the electromagnetic field generated by an exterior winding of the coil to exceed the electromagnetic field generated by the remainder of the coil. Claim 33 includes a similar limitation, but indicates the controller is arranged for varying the current supplied by the source to the windings for causing the electromagnetic field generated by the exterior winding to be less than the electromagnetic field generated by the remainder of the coil. The structures claim 32 and 33 define enable plasma density under different conditions within the chamber, for example pressure, to remain at the same described uniform distribution. Hence, the requirements of claim 32 and 33 are not a mere matter of design choice.

New claim 34 is similar to claim 33, but requires the current flowing in one of the windings to remain substantially constant and the current in the remainder of the coil to change. There is no art of record disclosing such an arrangement, which also assists in obtaining uniformity of the plasma under different conditions.

Newly added claims 35-40, which depend on claims 32, 33 or 34, define details of the windings of the coil of claims 32-34.

The rejection of claims 13-25 and 28-30 as being unpatentable over Chu et al. in view of Chen et al. WO 00/00993 is traversed. Firstly, applicants note that many features of these claims are not found in either of the references. For example, claim 16 requires the source to be an RF source, wherein the frequency of the source and the length of the windings are such that there are no substantial standing wave current variations along the length of each winding. Claim 19 includes a similar limitation, as do claims 24 and 28-30. This limitation is never discussed in the office action.

Claim 20, upon which claims 21-23 depend, requires the power of the source and the values of the reactances of the impedance arrangements respectively coupled with the plural parallel connected windings to be such that (a) the maximum amplitude of the standing wave current in one of the windings differs from the maximum amplitude of a standing wave current in the remainder of the coil and (b) adjacent windings to have standing wave currents maxima that are radially opposite from one another. The latter feature is not discussed in the office action, except perhaps tangentially in the sentence bridging pages 8 and 9 of the action. However, the specific feature of adjacent having current maxima that are radially opposite from one another, which assists applicants' device in achieving a more uniform plasma density, is never mentioned in the office action, nor is it disclosed or suggested by the art of record. The Chen et al. disclosure of a controller capable of varying the location and value of the maximum amplitude of a standing wave does not mean that Chen et al. has a disclosure of or makes obvious the feature of adjacent windings having standing wave current maxima that are radially opposite from one another.

The combination of Chu et al. and Chen et al. is incorrect because the Chu et al. coil arrangement is so different from the Chen et al. coil arrangement that one of ordinary skill in the art would not have combined the references. Chen et al. includes a coil with a pair of coaxial windings having different radii. In contrast, Chu et al. discloses a coil with many small, scattered windings

that couple magnetic flux into different portions of a plasma chamber, such that each winding couples the magnetic flux only into a small portion of the chamber. Many separate RF plasma sources 40, each of which includes a winding 46, are respectively associated with many small dielectric windows 26. In consequence, there is little point in locating a maximum inductive coupling point in each of the many coils Chu et al. employs. In Chu et al. variable capacitors 58 are tuning capacitors having values to adjust the output power of each RF antenna or coil 46. They have nothing to do with locating a maximum inductive coupling point. Chu et al. and Chen et al. are so different from each other that one of ordinary skill in the art would not have combined them to arrive at the combinations of claims 13-25 and 28-30.

Applicants traverse the rejection of claims 13-25 and 28-30 as being obvious from Sato et al. in view Tomioka et al. or Chu et al., as applied to claims 11, 12 and 31-33 and further in view of Chen et al. Applicants have previously demonstrated why the combination of Sato et al. with Tomioka et al. or Chu et al. is not applicable to claims 11, 12 and 31. Chen et al. fails to cure the deficiencies of this combination with regard to these independent claims. Further, Chen et al. fails to disclose the previously mentioned features of claims 16, 18, 20, 24 or 28; claims 21-23 which depend on claim 20, and claims 29 and 30 which depend on claim 28 are allowable with their independent claims.

Applicants traverse the rejection of claims 17 and 18 as being obvious as a result of Chu et al. in view of Van Gogh et al., US patent 6,579,426. Claims 17 and 18 depend ultimately on claim 12. Van Gogh et al. fails to cure the noted deficiencies of claim 12.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance are respectfully deemed in order.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

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